X-RAY AND LOW ENERGY GAMMA-RAY OBSERVATIONS OF THE 16 FEBRUARY 1984 SOLAR FLARE

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The 16 February 1984 (0900 UT) flare was very energetic and produced a variety of emissions. A preliminary summary of the X-ray, gamma-ray, radio and energetic particle observations has been presented earlier (Kane, 1985; Kane and Urbarz, 1986). Here we present only a brief description of the X-ray and gamma-ray continuum measurements. Implications of these observations with respect to the propagation and confinement of energetic electrons in the corona and the chromosphere have been discussed elsewhere (Kane *et al.*, 1987*a*).

The X-ray and low energy gamma-ray observations were made with instruments aboard the ICE (International Cometary Explorer, formerly ISEE-3) and PVO (Pioneer Venus Orbiter) spacecraft. The characteristics of the two instruments relevant to solar flare measurements have been described elsewhere (Kane *et al.*, 1982; 1987*b*). The X-ray and low energy gamma-ray continuum spectrometer on ICE consists of two detectors: a xenon-filled proportional counter covering 4.8–14 keV X-rays in 6 energy channels and a NaI(Tl) scintillator covering 26 keV–3.2 MeV photons in 12 energy channels. The time resolution is 0.5–4 seconds depending on photon energy. The PVO gamma-ray burst detector consists of CsI scintillators and covers 0.1–2 MeV photons in 4 energy channels. The time resolution is 0.5–8 seconds depending on the telemetry rate.

The 16 February 1984 (0900 UT) flare was probably located about 40° behind the west limb of the sun. At the time of the flare, ICE was located close to the sun-earth line and about 0.01 AU away from the earth in the sunward direction. The optical flare was thus completely occulted from the view of the ICE instrument. On the other hand, the PVO spacecraft, which was orbiting the planet Venus, was located about 16° behind the west limb of the sun. The flare was therefore in

full view of the PVO instrument.

Figure 1 shows the PVO and ICE observations. The soft X-ray measurements by GOES satellite are also presented for comparison. The PVO instrument detected a very intense burst of 100 keV–2 MeV photons beginning at about 0857 UT. The burst profile has considerable structure and appears to be related primarily to the impulsive phase of the flare. The impulsive hard X-ray burst and the gradual soft X-ray burst associated with such an intense gamma-ray burst are also expected to be very intense. However the ICE and GOES observations show that the impulsive hard X-ray burst was very weak and the gradual soft X-ray burst was undetectable, indicating that the very bright parts of these sources were occulted from the view of the near-earth instruments. This is consistent with the location of the flare being far behind the solar limb. It is interesting to note that the impulsive X-ray emission, as seen from the earth, could be detected down to about 8 Å in this flare. Also the ICE instrument detected the onset of high energy particles as early as ~0904:30 UT. This indicates that, at the sun, these particles were injected promptly at the foot of the spiral interplanetary magnetic field line passing through the earth.

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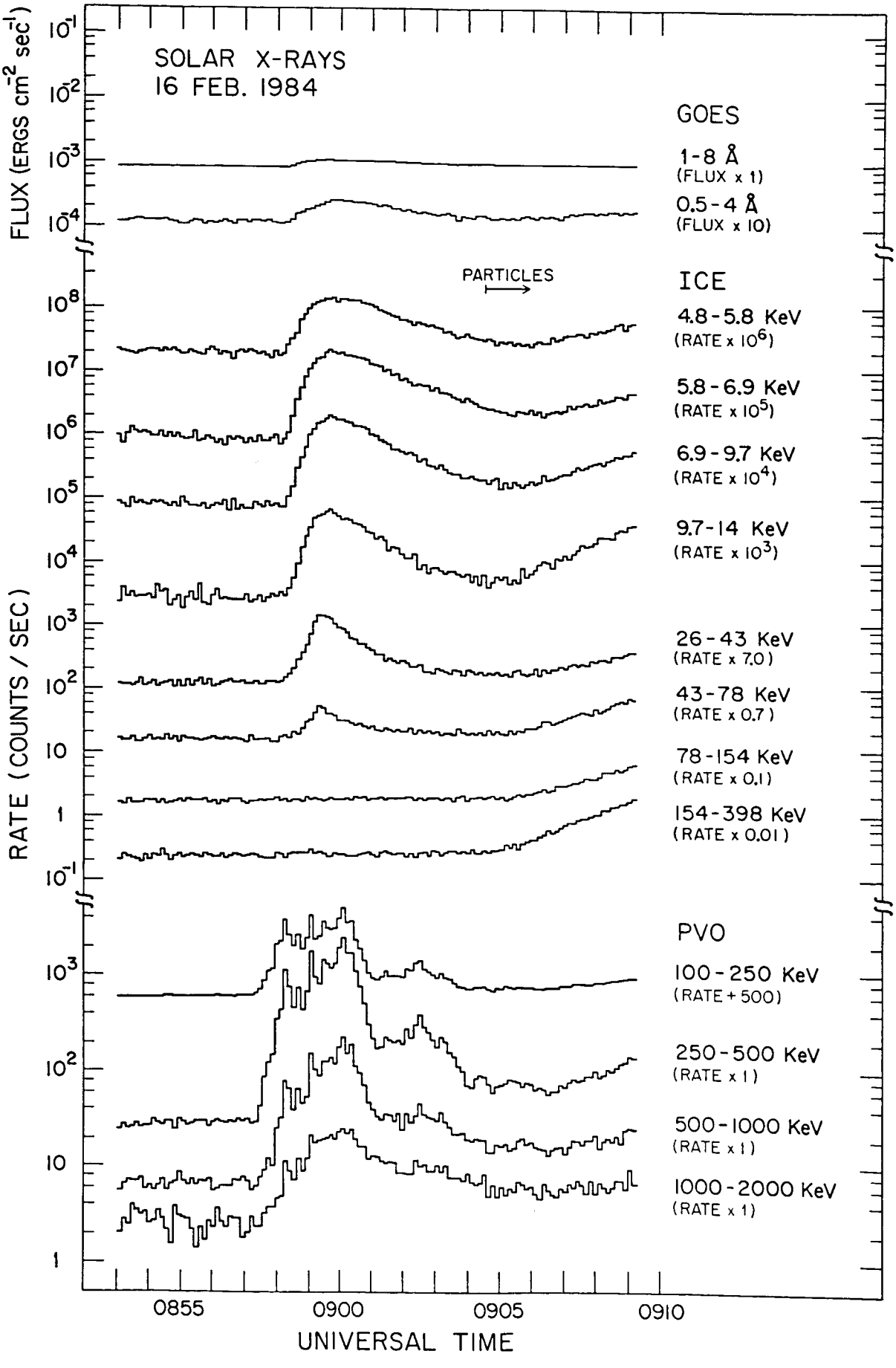
FIGURE CAPTIONS

Figure 1. The hard X-ray and low energy gamma-ray continuum observations of the 16 February 1984 solar flare made with the ICE and PVO spacecraft. The soft X-ray observations made with the GOES satellite are also shown. Note the intense photon flux observed by PVO. The flare was in full view of PVO which was located behind the west limb of the sun. However the chromospheric part of the X-ray source was occulted from the line of sight of ICE and GOES, resulting in a relatively small X-ray flux observed by these instruments. Also note the prompt onset of energetic particles in the vicinity of the earth detected by the ICE instrument.


SOLAR X-RAYS
16 FEB. 1984
FLUX (ERGS cm⁻² sec⁻¹)
RATE (COUNTS / SEC)
GOES
1-8 Å
(FLUX x 1)
0.5-4 Å
(FLUX x 10)
PARTICLES
ICE
4.8-5.8 KeV
(RATE x 10⁶)
5.8-6.9 KeV
(RATE x 10⁵)
6.9-9.7 KeV
(RATE x 10⁴)
9.7-14 KeV
(RATE x 10³)
26-43 KeV
(RATE x 7.0)
43-78 KeV
(RATE x 0.7)
78-154 KeV
(RATE x 0.1)
154-398 KeV
(RATE x 0.01)
PVO
100-250 KeV
(RATE + 500)
250-500 KeV
(RATE x 1)
500-1000 KeV
(RATE x 1)
1000-2000 KeV
(RATE x 1)
0855
0900
0905
0910
UNIVERSAL TIME